

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH75140
	REVISION SHSD FINAL Rev 0 RCD Draft Rev. 0
Atmospheric Testing with Integrated Sampling, i.e. Media & Pump Sampling (Active & Passive Sampling with Sorbents/Filters/Impingers)	DATE 04/24/01
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1.0 Purpose & Scope

This document describes a generic policy to follow for airborne contaminant sampling with a pump connected to a sorbent tube/impinger/or filter or with a passive badge. NIOSH or OSHA sampling and analysis methods must be followed for the particular sampling parameters for each contaminant to be sampled.

The goal of the procedure is to provide a uniform methodology to collect representative samples of chemical vapor, fumes, mists or particulates. Using this method will ensure that variation between various surveyors is minimized and that all pertinent data will be captured at the time of sampling. The use of this procedure is appropriate for OSHA and ACGIH occupational exposure limit (OEL) compliance testing.

Employee exposure assessments for occupational exposure compliance should be made with a personal, breathing zone sample collected on a sorbent/filter/impinger. Area samples (fixed location) using high volume samplers, may be necessary in limited situations for employee exposure assessments to attain the needed limit of quantification to determine OEL compliance. In these instances, the operations must be of short duration (15 to 30 minutes) and involve limited employee movement so that the fixed sample can measure the actual employee exposure.

2.0 Responsibilities

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- 2.1 Personnel that perform exposure monitoring with this procedure are responsible to follow all steps in this procedure.
- 2.2 **Demonstrated Competency:** This procedure is administered through the SHSD Industrial Hygiene Group and/or RCD Facility Support Division, depending on the organization of the surveyor. Only persons who have demonstrated competency in performing this test in accordance with Section 4 are authorized to use this procedure.
- 2.3 **Chain of Custody procedures:** The collector of the sample is responsible for the integrity of sample media and data sheets until it has been properly transferred to the SHSD IH Laboratory.
- 2.4 **Hazard Analysis of the Sampling Task:** It is the responsibility of the person using this method and his/her supervisor to ensure that the appropriate personal protective equipment is worn while performing this procedure. In addition, the person performing this procedure and his/her supervisor are responsible to ensure that all required training and qualification for hazards that may be present in areas where this procedure will be used (such as respiratory protection or radiation contamination) have been met. The person performing this procedure and his/her line supervisor are responsible to comply with all work planning and work permit system requirements.
- 2.5 **Evaluation of the Sampling data:** The data collected using an integrated sampler must have an appropriate evaluation of the hazard and risk to the exposed workers by a skilled Industrial Hygiene professional. It is the responsibility of the organization collecting the sample to ensure that the evaluation is completed.

3.0 Definitions

- 3.1 **Integrated Sampler:** A sampling train including an analytical media and associated sampling device capable of collecting an airborne contaminant for subsequent analysis and quantifying of the concentration. Examples would be a carbon tube or MCEF filter used with a calibrated air sampling pump or a sorbent containing passive sampling badge.

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3.2 **Program Administrator:** A person designated by the IH Group Leader or SHSD management to administer this procedure and the associated program of air sampling data management.

3.3 **Qualified Surveyor:** A person who has demonstrated competency, in accordance with Section 4, to perform this field procedure.

4.0 Prerequisites

4.1 **Qualification Criteria:** Use of this SOP shall be limited to persons who have demonstrated the competency to satisfactorily use the procedure, as evidenced by experience and training, to the satisfaction of their supervision or existing qualification criteria set by their organization.

4.1.1 **For SHSD:** The IH Group will maintain a record of SHSD personnel who have passed the competency test listed in Attachment 8.5. If significant and substantive changes to the procedure are made, *Qualified Samplers* will be notified of the changes.

4.1.2 **For RCD:** The qualification criteria, re-qualification frequency, and record keeping for RCD personnel are to be determined and documented by RCD management.

5.0 Precautions

5.1 **Hazard assessment:** The actual task of taking an integrated sample typically does not cause significant employee health risks. (Note: some impinger solutions are hazardous.) But by its very nature, this SOP may be performed in areas with chemical or radiation contamination, and these hazards must be assessed on a case-by-case basis. No one is to perform sampling until a knowledgeable individual has assessed the hazards of the area.

5.2 **Personal Protective Equipment:** Appropriate personal protective equipment to protect the person collecting the sample must be used when implementing this procedure. Where the potential for contamination of the body can occur, the use of disposable clothing to cover the areas of contact is required.

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- 5.2.1 **Hand:** Sample collection in areas of known or suspected chemical or radiological contamination requires the use of disposable gloves. Exam-style, splash gloves are acceptable. Acceptable elastomers are: Nitrile, PVC, and Natural Rubber.
 - 5.2.2 **Body:** If contact of the body with contaminated surfaces is anticipated, a disposable suit should be used. Acceptable chemical protective equipment materials include: Tyvek®, KleenGuard®, and cotton. Disposable garments must be discarded as hazardous waste if contact with contamination has occurred. If personal clothing items become contaminated, they must be surrendered for BNL cleaning or disposal.
 - 5.2.3 **Foot:** If contact of the feet is anticipated with contaminated surfaces, disposable shoe coverings, boots or booties should be used. Acceptable CPC material include: Tyvek®, KleenGuard®, and rubber. If personal shoes become contaminated, they must be surrendered for BNL cleaning or disposal.
 - 5.2.4 **Respiratory:** Under normal use, respiratory protection is not required. If chemical or radiological levels from contamination in the area exceed or are likely to exceed the OSHA, ACGIH, or DOE standards, respirators are required. A half face or full face APR or PAPR respirator with appropriate cartridge or an air line respirator may be used up to the assigned protection factor listed in the BNL's Respiratory Protection Selection and Issuance SOPs.
 - 5.2.5 **Eye:** Safety Glasses with side shields are required in laboratories, construction, and general industry areas. When hazardous chemicals can significantly injure the eyes, a full face respirator must be used.
- 5.3 **Radiation Contamination:** It is possible that some surfaces in areas to be tested may have radiation contamination. In these cases, personal protective equipment and administrative controls must be implemented for the radiation contaminant hazard in addition to the chemical hazard. In addition, the collected sample from these areas must be analyzed for the radiation hazard before it can be submitted to the SHSD IH Laboratory for analysis. At no time will the SHSD IH Laboratory accept a sample with radiation contamination above permissible limits for the general public.

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5.4 Work Planning: All requirements of work permits and work planning system reviews must be met in performing this procedure.

5.5 Environmental Impact and Waste Disposal: This sampling does not have adverse impact on the environment or create waste for disposal.

6.0 Procedure

6.1 Equipment-

- 6.1.1 **Media-** adsorbent, absorbent, filter, or impinger solution.
- 6.1.2 **Pump:** active sampling- portable, battery or line voltage operated, sampling device worn on the employee's belt or a fixed location sampler.
- 6.1.3 **Passive Dosimeter:** an adsorbent containing device with a permeable membrane. The dosimeter is worn on the worker's lapel that samples passively by diffusion.



6.2 Selection of Media: Contact an IH Group professional or other competent individual for assistance in selecting the appropriate media, sampling equipment, sampling parameters (flow rate), precautions or special handling needs, and post sampling storage requirements. Particulate media will be selected by the IH Lab based criteria listed in Attachment 8.5.

6.3 Sampling Technique:

- 6.3.1 OEL compliance sampling for employee exposure monitoring is done with a portable sampler with sorbent/filter attached in the breathing zone (lapel) of the worker, whenever possible. Fixed sampling is only permitted when portable sampling cannot provide the needed analytical sensitivity or the sampling equipment would cause a safety risk.
- 6.3.2 Area samples may also provide useful information. Determining the NUMBER and LOCATION of samples varies case-by-case. Professional judgment is needed in determining the sampling parameters based on

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factors such as the size of the area to be tested, the predicted uniformity of contamination within the area, relative hazard of the contaminant, and the accuracy, precision (repeatability), & sensitivity of the analytical method and the time of sampling. It is appropriate to take samples in:

- areas where workers predominately spend time or frequently access,
- at sources of the contamination (such as process equipment & lab apparatus),
- areas where contamination is not expected (serves as a control), and
- areas where contamination would not be permissible (such as lunch rooms and offices).

6.4 Preparation & Handling of Sampling Equipment

- 6.4.1 **Pre-calibration:** The IH Laboratory will pre-calibrate the sampling train using the field media or a representative media sample in line prior to field sampling.
- 6.4.2 **Post-calibration:** The IH Laboratory will post-calibrate the sampling train in accordance with IH75150 or IH75160 using the field media or a representative media sample in line after field sampling.
- 6.4.3 **Sample Storage:** The IH Laboratory will store exposed media in accordance with the NIOSH/OSHA method in the interim between return of the media from the field and shipment of the media to the analytical laboratory.
- 6.4.4 **Chain of Custody:** All provisions of IH51300 will be followed in processing samples for field use and shipment to the analytical laboratory.
- 6.4.5 **Laboratory Analysis:**
- 6.4.5.1 BNL may perform gravimetric analysis of samples at the IH Laboratory using a NIST traceable calibrated Microbalance as per NIOSH/OSHA methods.
- 6.4.5.2 BNL may analyze lead filters at the IH Laboratory using a factory calibrated XRF meter as per the NIOSH/OSHA method.

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6.4.5.3 BNL will ship samples to a fee-for-service AIHA PAT certified laboratory for quantitative analysis by Gas Chromatography, High Performance Liquid Chromatography, Atomic Absorption Analyzer, Inductively Coupled Plasma Spectroscopy, or other analytical technique described in a NIOSH or OSHA method.

6.5 Recording readings:

- 6.3.1 Use a BNL *Air Sampling Survey* Form to record important information on the sampling scenario (Attachment 8.2).
- 6.3.2 Return media, pump and original *Air Sampling Survey* form to the SHSD IH Laboratory.
- 6.3.3 The IH Group will maintain a copy of sampling results for at least 75 years.

6.6 Results interpretation:

- 6.6.1 A competent person should write a hazard evaluation report that evaluates the survey data and summarizes the potential for occupational exposure and compliance with OSHA and ACGIH Occupational Exposure Limits.
- 6.6.2 Ensure that a copy of the hazard evaluation report is sent to the IH Laboratory and is included in the ESHQ Directorate Recordkeeping system.
- 6.6.3 Ensure that a copy the written hazard evaluation report is sent to the Occupational Medicine Clinic with the worker(s) BNL Life Number(s) noted.
- 6.6.4 The hazard evaluation report and/or an *Employee Notification Form* (Attachment 8.3) must be used to inform all employees monitored or represented by the monitoring of the results of the air sampling and the implication to compliance with OELs. Reporting to employees must be within time limits established by regulatory drivers, as listed below:

Regulatory Driver	Chemical	Reporting Criteria
29CFR1926.62(d)(8)(i)	Lead	5 working days after completion of assessment
29CFR1926.1101(h)(3)	Asbestos	Standard cites: "As soon as possible"
10CFR850(g)(1)	Beryllium	10 working days of receipt of monitoring results
29CFR1910.1045(e)(5)(i)	Acrylonitrile	5 working days of the receipt of monitoring results

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Regulatory Driver	Chemical	Reporting Criteria
29CFR1910.1018(e)(5)(i)	Arsenic	5 working days of the receipt of monitoring results
29CFR1910.1028(e)(7)(i)	Benzene	15 working days of the receipt of monitoring results
29CFR1910.1051(d)(7)(i)	Butadiene	5 working days of the receipt of monitoring results
29CFR1910.1027(d)(5)(i)	Cadmium	15 working days of the receipt of monitoring results
29CFR1910.1047(d)(7)(i)	Ethylene Oxide	15 working days of the receipt of monitoring results
29CFR1910.1048(d)(6)	Formaldehyde	15 working days of the receipt of monitoring results
29CFR1910.1052(d)(5)(i)	Methylene Chloride	15 working days of the receipt of monitoring results
29CFR1910.1017(d)(5)(i)	Vinyl Chloride	<i>not specified</i>

- 6.6.5 Complete an *IH Database Entry* form (Attachment 8.4) and return to the IH Laboratory.

7.0 References

- 7.1 NIOSH Manual of Analytical Methods
- 7.2 OSHA SLC Laboratory Methods

8.0 Attachments

- 8.1 Airborne Chemical Sampling & Measurement Qualification record
- 8.2 Attachment 1: Air Sampling Survey form
- 8.3 Exposure Monitoring Employee Notification form
- 8.4 IH Database Entry form
- 8.5 Particulate Filter Selection Criteria

The only official copy is on-line at the SHSD IH Group website.
Before using a printed copy, verify that it is current by checking the document issue date on the website.

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9.0 Documentation

Document Review Tracking Sheet		
Prepared By: <i>(Signature and date on file)</i> R. Selvey 03/19/01 SHSD IH Group	Technical Reviewed By / Date: <i>(Signature and date on file)</i> J. Peters 03/19/01 SHSD IH Group R. Wilson 03/19/01 SHSD IH Group	Approved By / Date: <i>(Signature and date on file)</i> R. Selvey 04/24/01 IH Group Leader
Filing Code: IH52QR.01	QA Review / Date:	Effective Date: 04/24/2001

Periodic Review Record		
Date of Review	Reviewer Signature and Date	Comments Attached

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Safety and Health Services Division - Industrial Hygiene Group

Airborne Chemical Sampling & Measurement Qualification

Qualification Criteria: Only persons of the Industrial Hygiene Group who have demonstrated competency in SHSD IHG SOP IH75140 to the satisfaction of the IH Group Leader, Exposure Monitoring Program Administrator, or designee are authorized and allowed to receive samples. Personnel shall be re-qualified at a frequency not to exceed three years. **For SHSD:** The qualification criteria to perform this procedure for SHSD includes demonstrated competency to the satisfaction of the IH Group Leader or IHG Exposure Monitoring Program Administrator in the following areas:

- Knowledge of industrial hygiene practice (awareness level).
- Specific knowledge of this procedure.
- Demonstrated competency in performing this type of testing.

Name	Date of Qualification	Expires (3 years)
Qualified By: <div style="text-align: center;">Robert Selvey</div>	Qualifiers Title: <i>SHSD IH Group Leader</i>	Qualification Number: <div style="text-align: center;">GE - IHQ- 005</div>

Topic	Criteria	Qualification Status
Hazard Analysis	Can show how to perform (or who to request to perform) the hazard analysis of the sampling area and potential exposure to the sampler.	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Corrected <input type="checkbox"/> Not Qualified
Personal Protective Equipment	Understands the need to be aware of the potential surface contamination and airborne levels of contaminants and knows how to determine the need for PPE and how to obtain the correct PPE for the hazard.	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Corrected <input type="checkbox"/> Not Qualified
Sampling Equipment	Can show where equipment needed for the procedure is located and how to properly sign it out.	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Corrected <input type="checkbox"/> Not Qualified
Sampling Protocol	Understands the exposure monitoring logic necessary to appropriately select sampling locations to accurately measure worker, public and environmental exposure potential.	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Corrected <input type="checkbox"/> Not Qualified
Record forms	Can show how to correctly and completely fill all forms associated with this SOP.	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Corrected <input type="checkbox"/> Not Qualified
Analysis of data	Can show how to perform (or who to request to perform) the data analysis on the sampling data to access potential exposure to the sampler, worker, public and environment.	<input type="checkbox"/> Satisfactory <input type="checkbox"/> Corrected <input type="checkbox"/> Not Qualified

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BROOKHAVEN NATIONAL LABORATORY		AIR SAMPLING SURVEY FORM	
ENVIRONMENTAL, SAFETY, HEALTH & QUALITY DIRECTORATE - IH SERVICES		PAGE 1	
DATE:		SURVEYOR(S):	
SAMPLE#: _____ BLDG: _____ DATE (MM, DD, YY) _____ SAMPLE NUMBER _____ CONTAMINANT _____		CONTAMINANT:	

I. AREA INFORMATION		
DEPT:	BLDG:	ROOM:
SOURCE:		
ENGINEERING CONTROLS:		

II. EMPLOYEE INFORMATION		
FIRST NAME:	LAST NAME:	BNL #:
DEPT:	BLDG:	JOB TITLE:
EXPOSURE DURATION (HRS):	EXPOSURE (TIMES PER DAY):	EXPOSURE (DAYS PER YR):
JOB PERFORMED:		
EXPOSURE REPRESENTS: <input type="checkbox"/> TYPICAL WORK ACTIVITIES <input type="checkbox"/> TYPICAL AREA CONDITIONS <input type="checkbox"/> UNUSUAL EVENT <input type="checkbox"/> SPECIAL CIRCUMSTANCES		BALANCE OF DAY: <input type="checkbox"/> BALANCE OF SHIFT REPRESENTED BY SAMPLING PERIOD <input type="checkbox"/> BALANCE OF SHIFT HAD NO EXPOSURE TO THIS CONTAMINANT
PPE USED: (Respirator) _____ (Glove) _____ (Body) _____		
ADDITIONAL WORKERS REPRESENTED BY THIS SAMPLING: <input type="checkbox"/> ALL WITH SAME JOB TITLE / TRADE	NAME:	BNL#:
	NAME:	BNL#:

III. SAMPLING INFORMATION			
SAMPLING TIME		TEMP (°C) DURING SAMPLING	SAMPLE LOCATION
ON	OFF		
		START	(INDICATE APPROPRIATE SAMPLE TYPE) <input type="checkbox"/> PERSONAL SAMPLE: Worn on workers lapel (Breathing Zone) <input type="checkbox"/> FIXED BREATHING ZONE: Fixed location near workers nose/mouth <input type="checkbox"/> BLANK: Air not drawn through media <input type="checkbox"/> AREA SAMPLE (Select choice below) <input type="checkbox"/> SOURCE: Located at the source of the contaminant <input type="checkbox"/> BACKGROUND: Located in area without exposure to source <input type="checkbox"/> OTHER (describe): _____ <input type="checkbox"/> OPEN FACE <input type="checkbox"/> CLOSED FACE <input type="checkbox"/> I.O.M. <input type="checkbox"/> CYCLONE (4 MICRON)
		END	
		MIN	
		MAX	

BELOW THIS LINE TO BE FILLED OUT BY IH LAB PERSONNEL

IV. SURVEY INSTRUMENT INFORMATION					
INSTRUMENT (PUMP):		MODEL:		SERIAL#:	
MEDIA:		MFGR/PART#:		LOT#:	
CALIBRATION METHOD: <input checked="" type="checkbox"/> BIOS DC-1 CALIBRATOR <input type="checkbox"/> SOAP FILM BURETTE <input type="checkbox"/> SINGER DRY TEST METER		PRE-CAL:	BY:	POST CAL:	BY:
		FLOW:	TEMP: (°C)	FLOW:	TEMP: (°C)
TOTAL TIME (MIN):		AVG. FLOW:		TOTAL VOLUME (L):	
AVG. TEMP DURING SAMPLING:		TEMP CORRECTION FACTOR:		ADJUSTED VOLUME:	
Return completed form to: IH Lab, Building 129A				FORM IH75140 8.2 (03/01)	

Exposure Monitoring Employee Notification Record

This Section to be completed by Sample Submitter	
Send results to Responsible Party:	Name: _____ Building: _____ Responsible Party will be expected to notify workers of monitoring results within regulatory set time periods
Send copy to:	Name: _____ Building: _____
Send copy to:	Name: _____ Building: _____
Send copy to:	Name: _____ Building: _____
Copy to IHG:	_____ Selvey _____ Bernholc _____ Horn

This section to be completed by the Industrial Hygiene Group	
Received from Lab:	Date: _____ Hour: _____
Hardcopy of sent to Responsible Party:	Date: _____ Hour: _____
Phone call to Responsible Party:	Date: _____ Hour: _____
Report sent By:	_____ Wilson _____ Selvey _____ Bernholc _____ Horn

Notification to employee must be made by:	Date	Galson Login#	Asbestos Cof C#:

This Section to be completed by the Responsible Party before date above (within regulatory set time periods).	
Exposure in Compliance within Standards (ACGIH & OSHA) Employee Notification Review of this data indicates exposure levels were in compliance with regulatory limits. The employees represented by this exposure monitoring were informed of the results by: Name: _____ Date: _____	Exposure exceeds Standards (ACGIH or OSHA) Employee Notification Review of this data indicates exposure levels were ABOVE a regulatory limit. The employees represented by this exposure monitoring were informed of the results and corrective actions by: Name: _____ Date: _____
Note: If a formal BNL Memorandum is written, send a copy to the SHSD Industrial Hygiene Group (Building 129) and the Occupational Medicine Clinic (Building 490).	

Return this form to the **Industrial Hygiene Group (Building 129)**
as soon as employee notification is made.

Database Index#

IH75140 ATTACHMENT 8.4
IH DATABASE ENTRY FORM

IH Job Number:

Date	
Dept	
Building	
Source/Job	
First Name	
Last Name	
Life#	
Area Sampled	
Contaminant	
Concentration	
Units	___ ppm ___ mg/m ³
Sample Technique	<u> X </u> Sorbent / Filter
Sampled By	
Comments	

Data Entry By:	Date:
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IH75140 Attachment 8.5

Particulate Sampling Parameters

Compound	Standard	Fraction	TWA* (mg/m ³)	Sampler	Media	Flow (L/min)**
Arsenic	ACGIH	Total	0.01	Cassette	37mm MCE	1 – 3
	OSHA	Total	0.5	Cassette	37mm MCE	1 – 3
Beryllium	DOE	Total- TWA8	0.002	Cassette	37mm MCE	1 – 4
		Total- STEL	0.0010	Cassette	37mm MCE	1 – 4
	ACGIH	Total	0.002	Cassette	37mm MCE	2 – 2.5
	OSHA	Total	0.002	Cassette	37mm MCE	1 – 4
Cadmium	ACGIH	(Inhalable)	0.01	IOM	25mm MCE	2.0
		Respirable	0.002	Cyclone	37mm MCE	2.5
	OSHA	Fume	0.1	Cassette	37mm MCE	1 – 3
		Dust- Total	0.2	Cassette	37mm MCE	1 – 3
Chromium Metal	ACGIH	Total	0.5	Cassette	37mm MCE	1 – 3
	OSHA	Total	1.0	Cassette	37mm MCE	1 – 3
Chromium III	ACGIH	Total	0.5	Cassette	37mm MCE	1 – 3
	OSHA	Total	0.5	Cassette	37mm MCE	1 – 3
Chromium VI	ACGIH	Total	0.01	Cassette	37mm MCE	1 – 3
	OSHA	----	----	----	----	
Copper	ACGIH	Fume	0.2	Cassette	37mm MCE	1 – 3
		Dust	1.0	Cassette	37mm MCE	1 – 3
	OSHA	Fume	0.1	Cassette	37mm MCE	1 – 3
		Dust	1.0	Cassette	37mm MCE	1 – 3
Dust, PNOC	ACGIH	Respirable	3	Cyclone	37mm PVC	2.5
		Inhalable	10	IOM	25mm PVC	2.0
	OSHA	Respirable	5	Cyclone	37mm PVC	2.5
		Total	15	Cassette	37mm PVC	1.5 – 2
Fiberglass	ACGIH	Total	1 f/cc	Cassette	25mm MCE	0.5 – 16
	ACGIH	Total	5	Cassette	37mm PVC	1 – 3
	OSHA	Respirable	5	Cyclone	37mm PVC	2.5
	OSHA	Total	15	Cassette	37mm PVC	1 – 3
Iron Oxide	ACGIH	Total	5	Cassette	37mm MCE	1 – 4
	OSHA	Total	10	Cassette	37mm MCE	1 – 4
Lead	ACGIH	Total	0.05	Cassette	37mm MCE	1 – 4
	OSHA	Total	0.05	Cassette	37mm MCE	1 – 4
Nickel	ACGIH	Inhalable	1.5	IOM	25mm MCE	2.0
	OSHA	Total	1.0	Cassette	37mm MCE	1 – 4
Welding Fumes	ACGIH	Total	5	Cassette	37mm PVC	1

* As of : ACGIH = 1999 ACGIH TLV Booklet
OSHA = 29 CFR1910 on 5/27/99
see ACGIH or OSHA for most recent value

Media abbreviations:
37mm MCE = 37mm diameter Mixed Cellulose Ester
Membrane, 0.8 micron pore size
25mm MCE = 25mm diameter Mixed Cellulose Ester
Membrane, 0.8 micron pore size
37mm PVC = 37mm diameter Poly Vinyl Chloride
Membrane, 5.0 micron pore size

** OSHA & ACGIH Flow Rate and Media based on NIOSH Method unless noted below:

- IOM flow of 2.0 based on SKC, Inc. sampler specifications for 100 micron cutpoint)
- Cyclone flow of 2.5 based on SKC, Inc. sampler specifications for 4 micron cutpoint (ACGIH)
- Cyclone flow of 1.7 based on NIOSH method for 10 micron midpoint (OSHA)